

## Joel Lehman

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### CONTACT INFORMATION

Assistant Professor  
IT University of Copenhagen  
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### RESEARCH INTERESTS

Evolutionary robotics, neural networks, artificial intelligence

### ACADEMIC EXPERIENCE

**Assistant Professor, IT University of Copenhagen**, July 2015 - July 2016

**Employee #1 / Consultant, Deep learning startup in stealth mode**, January 2015 - Present

**Postdoctoral Researcher, University of Texas at Austin**, August, 2012 - January 2015

- Advisor: Risto Miikkulainen

**Ph.D., Computer Science, University of Central Florida**, August, 2012

- Dissertation Topic: “Evolution through the Search for Novelty”
- Advisor: Kenneth O. Stanley

**B.S., Computer Science, Ohio State University**, June 2007

### BOOKS

Why Greatness Cannot Be Planned: The Myth of the Objective. Kenneth O Stanley and Joel Lehman. 2015.

### JOURNAL PUBLICATIONS

Extinction Events Can Accelerate Evolution. Joel Lehman and Risto Miikkulainen. In: *PLoS one*. 2015.

Petalz: Search-based Procedural Content Generation for the Casual Gamer. Sebastian Risi, Joel Lehman, David D’Ambrosio, Ryan Hall, and Kenneth Stanley. 2015.

An Anarchy of Methods: Current Trends in How Intelligence is Abstracted in AI. Joel Lehman, Jeff Clune, and Sebastian Risi. *IEEE Intelligent Systems*. 2014.

Joel Lehman and Kenneth O. Stanley (2014). Investigating Biological Assumptions through Radical Reimplementation. *Artificial Life*. Accepted.

Matthew Hausknecht, Joel Lehman, Risto Miikkulainen, and Peter Stone (2013). A Neuro-evolution Approach to General Game Playing. *IEEE Transactions on Computational Intelligence and AI in Games*. Accepted.

Joel Lehman, Sebastian Risi, David D’Ambrosio, and Kenneth O. Stanley (2013). Encouraging Reactivity to Create Robust Machines. *Adaptive Behavior* 21:484–500.

Joel Lehman and Kenneth O. Stanley (2013). Evolvability is Inevitable: Increasing Evolvability without the Pressure to Adapt. *PLoS ONE* 8(4):e62186.

Joel Lehman and Risto Miikkulainen (2013). Neuroevolution. *Scholarpedia* 8(6):30977.

Joel Lehman and Kenneth O. Stanley (2011). Abandoning Objectives: Evolution through the Search for Novelty Alone. *Evolutionary Computation* 19(2):189–223. **Cited by: 271** (Google Scholar)

ARTICLES IN  
BOOKS

Invited chapter: Joel Lehman and Kenneth O. Stanley (2011). Novelty Search and the Problem with Objectives. In Riolo, Vladislaveva, and Moore (editors), *Genetic Programming in Theory and Practice IX (GPTP 2011)*.

CONFERENCE  
PUBLICATIONS

Joel Lehman, Sebastian Risi, and Jeff Clune (2016). Creative Generation of 3D Objects with Deep Learning and Innovation Engines. In: *Proceedings of the International Conference on Computational Creativity (ICCC 2016)*.

Henok Mengistu, Joel Lehman, and Jeff Clune (2016). Evolvability Search: Directly Selecting for Evolvability in order to Study and Produce It. In: *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO 2016)*. 2016.

Elliot Meyerson, Joel Lehman, and Risto Miikkulainen (2016). Learning Behavior Characterizations for Novelty Search. In: *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO 2016)*.

Arend Hintze, Randal S Olson, and Joel Lehman (2016). Orthogonally Evolved AI to Improve Difficulty Adjustment in Video Games. In: *Applications of Evolutionary Computation*. **Nominated for Best Paper Award in EvoApps**

Diana F Galvao, Joel Lehman, and Paulo Urbano (2015). Novelty-Driven Particle Swarm Optimization. In: *Artificial Evolution*.

Joel Lehman and Risto Miikkulainen (2014). Overcoming Deception in Evolution of Cognitive Behaviors. In *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO-2014)*. **Nominated for the Best Paper Award in the Artificial Life track**

Joel Lehman, Kenneth O. Stanley, and Risto Miikkulainen (2013). Effective Diversity Maintenance in Deceptive Domains. In *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO-2013)*. 215–222.

Sebastian Risi, Joel Lehman, David B. D'Ambrosio, Ryan Hall, and Kenneth O. Stanley (2012). Combining Search-based Procedural Content Generation and Social Gaming in the Petalz Video Game. In *Proceedings of the Artificial Intelligence and Interactive Digital Entertainment Conference (AIIDE 2012)*.

David B. D'Ambrosio, Skyler Goodell, Joel Lehman, Sebastian Risi, and Kenneth O. Stanley (2012). Multirobot Behavior Synchronization through Direct Neural Network Communication. In *Proceedings of the 5th International Conference on Intelligent Robotics and Applications (ICIRA-2012)*. 603–614.

Joel Lehman and Kenneth O. Stanley (2012). Beyond Open-endedness: Quantifying Impressiveness. In *Proceedings of Artificial Life Thirteen (ALIFE XIII)*. 75–82.

Joel Lehman, Sebastian Risi, David B. D'Ambrosio, and Kenneth O. Stanley (2012). Rewarding Reactivity to Evolve Robust Controllers without Multiple Trials or Noise. In *Proceedings of Artificial Life Thirteen (ALIFE XIII)*. 379–386.

David B. D'Ambrosio, Joel Lehman, Sebastian Risi, and Kenneth O. Stanley (2011). Task Switching in Multirobot Learning through Indirect Encoding. In *Proceedings of the International Conference on Intelligent Robots and Systems (IROS)*. 2802–2809.

Joel Lehman and Kenneth O. Stanley (2011). Evolving a Diversity of Virtual Creatures through Novelty Search and Local Competition. In *Proceedings of the Genetic and Evolutionary Computation*

*Conference (GECCO-2011)*. 211–218.

Joel Lehman and Kenneth O. Stanley (2011). Improving Evolvability through Novelty Search and Self-adaptation. In *Proceedings of the 2011 IEEE Congress on Evolutionary Computation (CEC)*. 2963–2700.

Joel Lehman and Kenneth O. Stanley (2010). Revising the Evolutionary Computation Abstraction: Minimal Criteria Novelty Search. In *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO-2010)*. 103–110.

Joel Lehman and Kenneth O. Stanley (2010). Efficiently Evolving Programs through the Search for Novelty. In *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO-2010)*. 837–844.

Sebastian Risi, Joel Lehman, and Kenneth O. Stanley (2010). Evolving the Placement and Density of Neurons in the HyperNEAT Substrate. In *Proceedings of the Genetic and Evolutionary Computation Conference (GECCO 2010)*. 563–570.

**Winner of the Best Paper Award in the Generative and Developmental Systems (out of 20 submissions in track)**

David B. D’Ambrosio, Joel Lehman, Sebastian Risi, and Kenneth O. Stanley (2010). Evolving Policy Geometry for Scalable Multiagent Learning. In *Proceedings of the International Conference on Autonomous Agents and Multiagent Systems (AAMAS)*. 731–738.

Joel Lehman and Kenneth O. Stanley (2008). Exploiting Open-Endedness to Solve Problems Through the Search for Novelty. In *Proceedings of the Eleventh International Conference on Artificial Life (ALIFE XI)*. 329–336. **Cited by: 183** (Google Scholar)

WORKSHOP,  
SYMPOSIA, AND  
INVITED  
PUBLICATIONS

General Video Game Playing as a Benchmark for Human-Competitive AI. Joel Lehman and Risto Miikkulainen. In: *AAAI-15 Workshop on Beyond the Turing Test*. 2015.

Sebastian Risi, Joel Lehman, David B. D’Ambrosio, and Kenneth O. Stanley. Automatically Categorizing Procedurally Generated Content for Collecting Games. In: *Proceedings of the Workshop on Procedural Content Generation in Games (PCG) at the 9th International Conference on the Foundations of Digital Games (FDG-2014)*.

Joel Lehman and Kenneth O. Stanley (2013). Exploring Biological Intelligence through Artificial Intelligence and Radical Reimplementation. In: *Proceedings of the 2013 AAI Fall Symposium on How Should Intelligence be Abstracted in AI Research*.

Joel Lehman and Risto Miikkulainen (2013). Boosting Interactive Evolution using Human Computation Markets. In: *Proceedings of the Conference on the Theory and Practice of Natural Computation (TPNC 2013)*.

Joel Lehman and Risto Miikkulainen (2013). Leveraging Human Computation Markets for Interactive Evolution. In: *Proceedings of the Machine Learning Meets Crowdsourcing Workshop at ICML 2013*.

Joel Lehman, Sebastian Risi, and Kenneth O. Stanley (2012). On the Benefits of Divergent Search for Evolved Representations. In: *Proceedings of the EvoNet 2012 Workshop at ALIFE XIII*.

PATENTS PENDING David D’Ambrosio, Sebastian Risi, Joel Lehman, Amy Hoover and Kenneth O. Stanley (Provisional Patent Pending since 2011). Means of Representing, Generating, and Incrementally Modifying

Aesthetically Pleasing Digital Images of Flowers. University of Central Florida.

#### INVITED TALKS

“Practical Procedural Content Generation.” *Global Game Jam Copenhagen*. Copenhagen, Denmark, Jan 29, 2016.

“Creative Algorithms for Evolving Robots.” *Cafe Neu Romance*. Prague, Czech Republic, October 15, 2015.

“Computational Intelligence in Video Games.” *Explore UT*. Austin, TX, March 2, 2013.

“Abstracting Evolution’s Creativity as a Search for Novelty.” *BEACON seminar*. Austin, TX, January 25, 2013.

“Evolving Artificial Brains in a Computer.” *BHC Summer Institute*. Orlando, FL, July 9, 2012.

“Evolving Artificial Brains in a Computer.” *Junior Knights*. Orlando, FL, May 12, 2012.

#### PRESS COVERAGE

- FiveThirtyEight, 2015. Stop trying to be creative.
- Wired.co.uk, 2015. Exterminate most robots, and an unstoppable breed will emerge.
- Daily Mail, 2015. Are mass extinctions a good thing?
- DNews (Discovery Channel Youtube Outlet), 2013. Can we evolve without competition?
- KurzweilAI News, 2013. A new spin on origins of evolvability: survival of the evolvable.
- Communications of the ACM, 2013. Computer scientists suggest new spin on origins of evolvability.
- Examiner.com, 2013. Computer scientists’ surprising new theory of evolution.
- Science Daily, 2013. Computer scientists suggest new spin on origins of evolvability: competition to survive not necessary?
- Research also covered in the following: Phys.org, io9, Archaeology News Network, Science World Report, eScienceNews, Planet Tech, and 10+ other venues.

#### GRANTS, FELLOWSHIPS, AND AWARDS

- Lead PI of a successful funding request to the BEACON Center for the Study of Evolution in Action titled “Leveraging Human Computation Markets to Evolve Complex Behaviors.” \$24,661
- Significant Contribution to Funded Proposal. US Army Research Office (ARO), “Training a Multiagent Hive Brain for Coordinated UGV Operations,” September 2011 - September 2014, \$150,000 (first increment). (PI Kenneth O. Stanley)
- Significant Contribution to Funded Proposal. Defense Advanced Research Projects Agency (DARPA) Computer Science Study Group Phase 3, “Real-world Scalable Multiagent Learning for Coordinated UGV Operations,” August 2011 - August 2012, \$249,347. (PI Kenneth O. Stanley)
- Best Paper Award, Genetic and Evolutionary Computation Conference, 2010 (Generative and Developmental Systems Track)
- University of Central Florida Trustees Doctoral Fellowship, 2008
- National Merit Scholar, 2002

STUDENT  
SUPERVISION

- Pei-Chi Huang, Ph.D. student evolving neural networks to control robotic grasping of objects (2012-2013).
- Christopher Donahue, undergraduate evolving real-time synthesizers with genetic programming (2012-2013).
- Eric Yu, undergraduate evolving teams of agents for a video game (2012-2013).
- Jacob Bobb, undergraduate combining particle swarm optimization with novelty search (2012-2013).
- Randy Olson, co-advised undergraduate thesis on evolving walking gaits for a biped robot with novelty search (2009-2010).

PROFESSIONAL  
EXPERIENCE

**Co-founder, Finchbeak LLC** **2012- 2015**  
Start-up company based on applying AI research to social video games (<http://finchbeak.com>).

**Google Summer of Code 2009, Open Cog Project** **May, 2009 - August, 2009**  
Extended the MOSES evolutionary algorithm to evolve artificial neural networks.

**Cerner Corporation, Software Engineer Intern** **June, 2006 - September, 2006**  
Developer for implementing automated GUI testing.

**Lexmark international, Software Engineer Intern** **December, 2005 - September 2005**  
Developed real-time filtering algorithm for integrated system.

TEACHING  
EXPERIENCE

- Instructor for Freshman Research Initiative course sequence titled “Computational Intelligence in Video Game Research,” University of Texas at Austin, Since 2012. Responsibilities: Developing course curriculum, lecturing, grading, supervising undergraduate mentors, supervising undergraduates with research projects.
- Guest lecture for an Artificial Intelligence class, University of Texas at Austin, 2013
- Participated in the New Faculty and Mentors Teaching Strategies Workshop, University of Texas at Austin, 2013
- Participated in the Preparing Tomorrow’s Faculty Program, University of Central Florida, 2012. Received training in course design, delivery of instruction, teaching strategies, collaborative learning and classroom management.
- Guest lecture for a Machine Learning class, University of Central Florida, 2009
- Guest lecture for a Generative and Developmental Systems class, University of Central Florida, 2009

SERVICE

- Organizer of 2016 GECCO Virtual Creatures Competition
- Co-organizer of 2014 & 2015 GECCO Virtual Creatures Competition
- Co-organizer of 2013 AAAI Fall Symposium on “How Should Intelligence be Abstracted in AI”
- Member of IEEE CIS Task Force on Towards Human-like Intelligence
- Member of the Review Editorial Board for Frontiers in Robotics and AI
- Reviewer:
  - PLoS One
  - Journal of AI Research
  - Journal of Autonomous Agents and Multi-Agent Systems
  - Entropy journal
  - Evolutionary Computation journal
  - Transactions on Computational Intelligence and AI in Games

- Transactions on Systems, Man, and Cybernetics
- Genetic Programming and Evolvable Machines
- Artificial Intelligence journal
- IEEE Transactions on Evolutionary Computation
- Artificial Life conference
- Congress on Evolutionary Computation conference
- ANTS (Swarm Intelligence) conference
- IEEE Symposium Series on Computational Intelligence
- Genetic and Evolutionary Computation conference
- European Conference on Artificial Life

#### REFERENCES

- Risto Miikkulainen, Professor, Departments of Computer Science and Neuroscience, University of Texas at Austin. Postdoctoral advisor. risto@cs.utexas.edu, (512) 471-9571.
- Kenneth O. Stanley, Associate Professor, School of Electrical Engineering and Computer Science, University of Central Florida. Ph.D. Advisor. kstanley@eecs.ucf.edu, (407) 473-0072.
- Joshua Bongard, Associate Professor, Department of Computer Science, University of Vermont. josh.bongard@uvm.edu, (802) 656-4665.